Minutes for AMiBA Engineering Telecon

Meeting Date: 21-November-2002

Participants:
Australia:
USA: J. Peterson, M. Kesteven, C.J. Ma, J. Han, T. Huang, B. Martin
Taiwan: H. Jiang, J. Lim, W. Ho, P. Ho, P. Shaw, C.T. Li, E. Hwang, Proty Wu, Kyle Lin

Minutes Recorder: C.T. Li
comments from this week, previous weeks comments

Test progress and future plans:

Mike: calibrated the mount; measuring the alignment between two receivers, dishes, and optical telescope; beam efficiency measurement with Jupiter; correlator offsets and ground pickup; cross polarization on the Moon

Things to try –
1. displace one dish a little(1mm movement <-> 10 arc-min) to verify the resulting order of magnitude of error
2. stop the phase switching to see how the correlator offsets change (instead of disconnect one of the IF), or try to balance the phase switch outputs
3. put absorber over dishes to see if the correlator offsets were caused by antenna-to-antenna coupling

Please see Mike's recent reports in the end

Tasks –
1. total power stability – power level jump in slow phase switching Rx
2. optical alignment
3. offsets
4. implementation of transmitter, used for field alignment

I. New Action Items:

Alignment summary: >> Mike *etal.* : summarize the current mis-alignment between receivers and optical telescope, then people can discuss best ways to adjust them.

Test log setup: >> Proty: have test logging on-line and working by next meeting.

Wait for removing VPN, then put correlator and monitor computers within MLO's secure domain. Enhance web site with data searching capability.

II. Previous Action Items (still open):

14nov02-1: Mount CDR & 7-Element Reviews: >> Bob: Organize and pin down dates for the Vertex mount CDR as well as the review of 7-element system.
Please see the email about updated schedule from Jackie in the end

14nov02-2: Update Prototype Poster: >> Ming-Tang: Paul S. asked that the prototype poster be updated to show our most recent results and photos of the ML hardware. He would like to show this poster during the MOE visit on Nov 29.
C.T. will put together another poster to show our most recent test results on MLO

7nov02-1: 60cm Dishes >> Bob/Philippe: The dish manufacturer is having some problems with the CAD drawings. Arrange telecon to discuss and resolve the problems.
Revision of drawing is done. Ted will arrange a telecon with Along? next week.
Ted has distributed some revised drawings and Philippe arrives in Hilo this Friday. Bob, Ted and Philippe will have a telecon with manufacturer before the meeting next week.

7nov02-3: CW Source on Tower >> Derek: Make sure it is OK for us to radiate a CW signal in the 85-105 GHz range at ML.

Waiting for someone to climb the tower.
Installation of radio transmitter is on the task list for the following weeks.
Derek spoke to John Barns of MLO just after the engineering meeting today. John has had some problems in the past with a transmitter interfering with a photomultiplier detector he is using near us. He asked that we tell him once our transmitter is up so that he can make sure it does not affect his equipment by perform measurements with the transmitter on and off. This action is closed but will be held here until the next meeting.

23oct02-2: Clock Drive Motor >> Ted/Ferdinand: Ted to characterize the torque for the clock drive shaft with the mount loaded. Thereafter, identify and order a motor.

Ferdinand are reviewing the specs. Ted and Ferdinand will place the order then. Bob envisioned that the motor won't be installed probably until Jan. or Feb. next year.
Torque with platform loaded is 7nm. Mike asked Ted to repeat the torque measurement over a larger angle to make sure it is relatively consistent. Ted mentioned that there are still some other issues to address regarding the motor.

03oct02-3: Test Schedule >> Bob: Expand schedule to include retrofitting of the following: new version 2 receiver, 4-lag correlators, 60 cm dishes, new DC amplifier and readout boards.

Continue testing until middle of December (tentative)
Discuss various tests performed in the past week and future plans along the way

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III. Closed Action Items (as of this meeting):

03oct02-1: Site Clock >> Bob, Ferdinand: Identify and order site clock.

Order has been placed.

IV. Miscellaneous Discussions:

V. Other Inputs:

Updated CDR meeting schedule from Jackie -

Dear Sirs,

Please be advised that AMiBA CDR Meeting will be held from Dec.16 to Dec.19
in Taipei.
Dec. 16 for Receiver, LO, etc.
Dec. 17-18 for Vertex mount, etc.
Dec. 19 for informal discussion

Please kindly mark it on your calendar and join.
For those who are coming from other countries, please let me know your
fixed flight schedul as soon as you can.

And Bob, please tell me who will be coming from Vertex, and their flight
schedule as well once you have.

THANKS IN ADVANCE FOR ALL YOUR COOPERTION.

Best regards,
Jackie Wang

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2002-11-13.report from Mike -

Prototype tests 13-14 Nov.

observers:
proty; ming-tang; derek; ted; cheng-jiun; johnson; mjk.

weather: clear; cold; windy

1. Set the mount zero points.

- with the inner octagon horizontal, set the turntable dials to read 0 degrees; 0 minutes.
- the electronic tiltmeter is clamped to the dewar top plate, aligned normal to the declination axis.

A workable (though tedious) pointing procedure:
- turn the HA axis to HA = 0
- tilt the inner octagon to (dec - 19.539)
- turn the HA axis to the required HA

We now (18 nov) find that subtracting 0.1 degree from the dec.
puts the source on the radio beam centre.
This will need revisiting when the HA axis is reset.

2. Measure the alignment between the optical telescope and the mean radio beam.

The moon was observed (in the east), at various offsets from the actual delination.
The radio beam was found to be offset by 60.5 (+/- 2) secs (later) relative to the optical.
The radio beam was found to be ~10 arcmin south of the optical.
(see 16/17 nov results for updates).
file : moon_dec_201113_201930.log

3. Refine the Dec. offset; (and assess the phase stability).

- set the platform declination to the moon's declination, for a time ~20 minutes in the future; then advance the HA to obtain a sequence of transits.
The moon's shifting declination means that these transits probe the declination offset, without requiring a platform adjustment.
(yet to be fully processed).
file : moon_ourangle_021113_211529.log

4. Total power scans on the moon. These showed that the two dishes were offset in HA by about 40 secs of time.

As a result of this, and from Ming-Tang's observation that he could see (from the moon's image) that there was a similar offset in declination, the dish installation was checked (without success) readjusted on 16-17 nov.
file : moon_TP_021113_224412.log
moon_tp_13nov.ps

5. Refine the polar axis question.

Observe a dozen or so stars over as wide a range of HA as possible
(roughly +/- 45 degrees)
All were seen without trouble.

Proty to process.

6. Ground pickup.

Observe blank sky. It was found that each lag had a fixed offset, different for each lag.
Quantitatively: the rms on each lag, with 0.452 secs integration, is around 20 units; the offsets ranged from 0 to -40 units.
The noise does not seem "white", and was independent of the platform orientation.
This question was revisited 16-17 nov.

file : ground_pickup_021114_011535.log

7. Jupiter observation. This probes the system gain.

file : jupiter_021114_030139.log

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the files identified here can be found at : amibadata/calibration

2002-11-16.report from Mike -

prototype tests .. 16/17 nov

observers : ted, johnson, cheng-jiun, mjk
weather : cold, somewhat cloudy, very windy

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1. Realign the 30 cm dishes on the dewar.

This amounted to removing a flat washer installed between the spherical washers.
The operation made no difference - still left with 10 arcmin offset in HA.

2. Correlator offsets.

5 minute tracks were made under different rx combinations:
(a) (Rx1,IF1) * (Rx2,IF1) - basic parallel polarisation
(b) (Rx2,IF1) alone
(c) (Rx1,IF1) alone
(d) (Rx1,IF1) * (Rx2,IF2) - cross polarisation
(b) and (c) showed no offsets; (a) and (d) showed the same offsets.

A further 5 min track was made after the IF levels were raised by 3 dB (to -15 dBm).
Most offsets increased by a factor of ~2.5;
the rms by ~2.0 lag channel -1 did not appreciate the change, and now has low gain.
lag channel +15 seems very noisy.
files : corr_offset_021116_162635.log
corr_offset_021116_173713.log

3. Skydip

A skydip was trialled - from platform horizontal to HA = -30 and -45 degrees.
(note that we overshot down to -50, briefly).
The effect is visile, but the total power was also wandering substantially.
Most worrying are the TP jumps.
file : skydip_021116_174840.log
see also TP_drift_021116_181700.log

4. Total power scans on the moon - to assess the alignment of the two radio beams.

Scans were made at the moon declination, as well as at several offsets from nominal.
file : moon_TP_021116_190609.log
moon_tp_16nov.ps

This run, and the previous experiment (skydip) suggest that changing the IF power levels was not appropriate - there seem to be significant jumps and non-white noise.
See tp_noise_13nov.ps and tp_noise_16nov.ps

analysis:

the two radio beams are offset by 42 (+/- 1) seconds time, with the slow phase switch rx seeing the moon later than the fast switch.

(compare the 2 postscript files, moon_tp_date.ps).
there is also an declination offset of ~5-10 arcmin, but this is not well measured at this stage.
the beamwidth is 184 seconds time
the radio/optical alignment was previously found to be 62 (+/-2)
seconds with the radio later than the optical

5. Polarisation

A sequence of moon scans: parallel, cross, cross, parallel hand.
about 3% polarisation was seen.
file : moon_pol_021116_204621.log

6. Saturn.

Two scans at the nominal declination; three with -0.1 degree offset.
Saturn unhappily was clouded over, so the SNR is not good, but the detection was OK.
(some averaging is required)
This dataset will be used as a simple trial of scan alignments:
use the optical data to provide timing references for the radio data.
file : saturn_021116_224044.log
saturn.fits

7. The data archiving with RPFITS format was activated. It was in place for the last two experiments.

(see moon.fits --- with moon_fits_021116_221435.log as parallel copy; saturn.fits and saturn_021116_224044.log)

Comments:

1. The site is quite dangerous at night - a reliable supply of flashlights is essential; or, possibly, low level permanent lighting.

2. It would be useful to have the optical telescope monitor inside the dome, alongside the monitor computer.

3. The work space in the dome could be made more comfortable.

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files are in amibadata/calibration

`Correlator offset report from Mike -`

Correlator offsets

1. The data.

we measured the correlator output with the platform pointing at blank sky (towards the zenith).
we measured the multiplier outputs on ch0.
the rms on all multipliers was in the range 20-25 computer units (CU), on a 0.452 sec sample time.
(with Tsys ~ 160K; B ~ 4 GHz; tau = 0.452, this implies : rms = 3.7 mK, or 1 CU = 0.2 mK).
the offsets were all negative, in the range 0 to -40 CU
we carried a few further tests:

- disconnecting either IF cuts the rms by root(2); and the offsets are all essentially zero (in the range -2 to 0 CU).
- switching to cross-polarisation made no change - same rms and offsets as for parallel pol.
- no change was noted when the platform was tipped to HA=45 degrees. (not a strong test, as no data was logged).
- raising both IF powers by 3 dB increased the rms by ~ 3dB; the offsets also increased, but somewhat variably - but roughly a 4 dB increase.

2. The problems.

The double phase switching should not allow an offset - how does it get through?
Is it stable -- if it is associated with total power leakage, then it will have (1/f) characteristics, and will be hard to handle.
Or is it correlated signal?

3. Some thoughts.

Two possible mechanisms have been (so far) advanced.

a. We know that the multipliers have an output component proportional to the total power of each IF.
It is suggested that the proportionality constant for each IF is related to the power of the other IF:

output = a(B)*A^2 + b(A)*B^2

Under these circumstances the demodulated output will contain a term:

(da/dB)*DeltaB*DeltaA*A and its mirror image (db/dA)*DeltaA*DeltaB*B

b. If the phase switch were to take longer to settle down after the transition to state 1, compared to the transition to state 2, then the slow phase-switched receiver will generate an offset.

(More generally, an offset will result if the slowest switching cycle is not uniform over a fast phase-switch cycle.

3. Some tests.

a. Is the offset due to a correlated signal?

one test would be to introduce a line-stretcher in the LO line to one receiver.

Changing the phase should change all the multiplier products

(each multiplier should advance through a full SIN over a line extension of lambda).

b. What is the power specdtrum of the offset?

c. Determine the power level changes (DeltaA and DeltaB).

(The slow phase switch difference can be found by running the Total Power in no-demod mode.

Our data last week indicated that the step runs at about 0.6% of the mean level.

d. Determine (da/dB) and (db/dA)

(from wew :

How about:

Correlator response to input signals A & B = A.B + a.A**2 + b.B**2

i.e. normal multiplied output plus squared terms - BUT - let's say that a is a function of B, and b of A. I'm thinking of some non-linear effect which causes a to change value (slightly) with changing B. With one input, say B, removed, a is constant and so the quadrature phase switching will remove the squared term.

Could be tested by:

Turn slow phase switching, say in input B, off. i.e. nodemod.

Now we see the offsets due to the differential losses in the A phase switch and the A squared terms.

Vary the input level of B - only by a small amount, of the same order as might be caused by the differential losses in the B phase switch - look for changes in the output offsets.

e. Is the IF power level from the slow phase switch rx symmetrical
(uniform) over the fast phase switch cycle?